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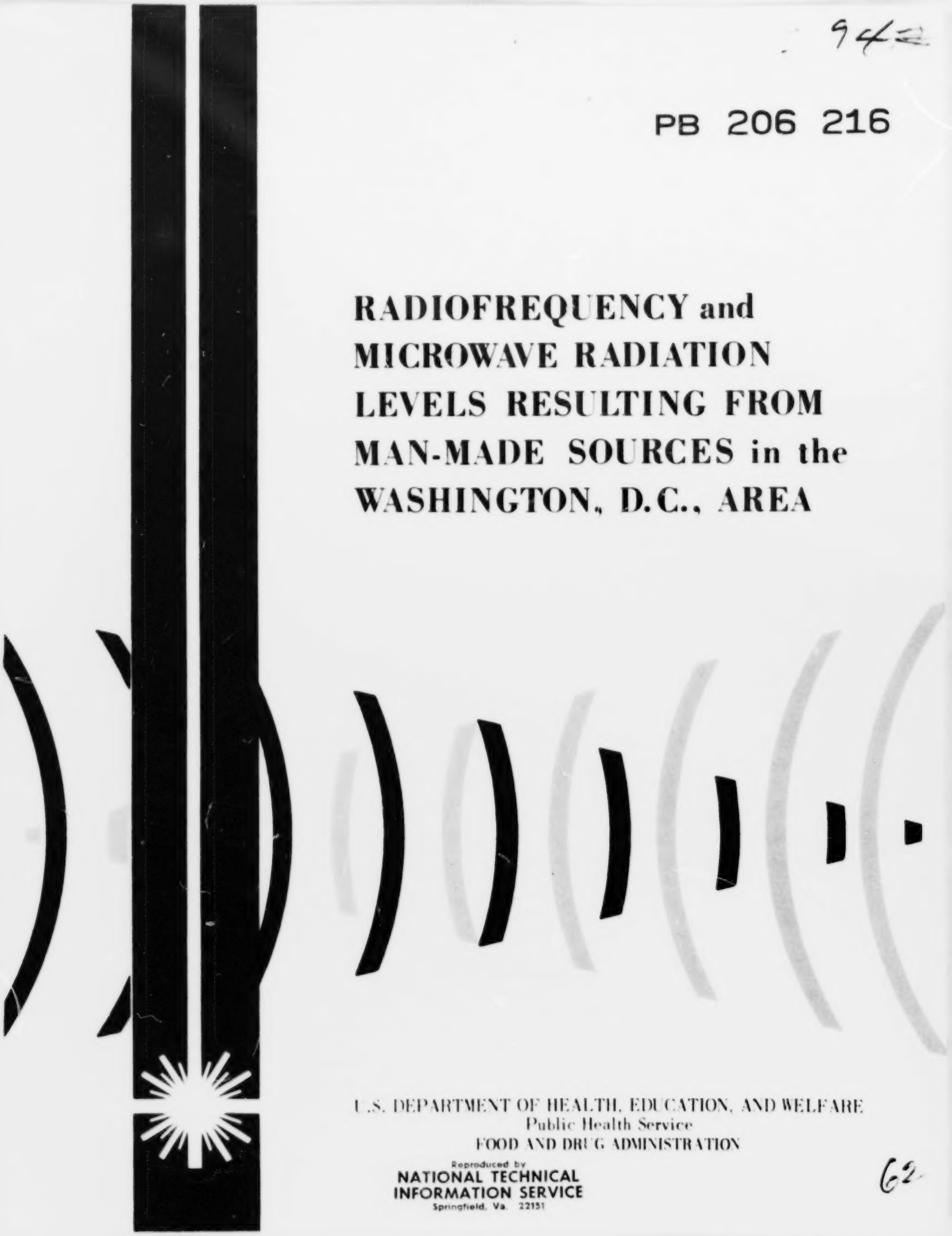
RADIOFREQUENCY and MICROWAVE RADIATION LEVELS RESULTING FROM MAN-MADE SOURCES in the WASHINGTON, D.C., AREA



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RADIOFREQUENCY and MICROWAVE RADIATION LEVELS RESULTING FROM MAN-MADE SOURCES in the WASHINGTON, D.C., AREA

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Product Testing and Evaluation Branch
Division of Electronic Products

Data obtained by
White Electromagnetics, Incorporated
under
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November 1971

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U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
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FOREWORD

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Within the Bureau, the Division of Electronic Products (1) develops and administers performance standards for radiation emissions from electronic products, (2) studies and evaluates emissions of and conditions of exposure to electronic product radiation and intense magnetic fields, (3) conducts or supports research, training, development, and inspections to control and minimize such hazards, and (4) tests and evaluates the effectiveness of procedures and techniques for minimizing such exposures.

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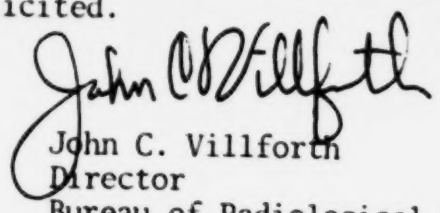
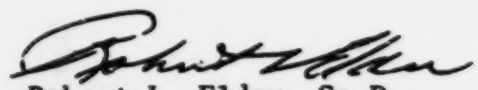
I encourage the readers of these reports to inform the Bureau of any omissions or errors. Your additional comments or requests for further information are also solicited.



John C. Villforth
Director
Bureau of Radiological Health

PREFACE

The Division of Electronic Products, Bureau of Radiological Health, as a part of its responsibility under the Radiation Control for Health and Safety Act of 1968, has carried out a measurement survey to determine typical levels of radiofrequency and microwave radiation resulting from man-made sources in an urban environment. Peak power densities were measured in the Washington, D.C., area during the summer of 1969, and the results are reported herein.



Robert L. Elder, Sc.D.
Director
Division of Electronic Products

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We are grateful for the valuable assistance of Charles F. Grayson, Jr., Intelligence Branch, Division of Electronic Products, Bureau of Radiological Health, in the computer analysis of the background data.

ABSTRACT

In order to determine the typical levels of radiofrequency and microwave radiation that result from man-made sources in an urban environment, measurements were made of peak power densities in the Washington, D.C., area during the summer of 1969. The highest levels measured (approximately 10^{-2} mW/cm^2) originated primarily from AM broadcast towers and airport radar installations.

RADIOFREQUENCY AND MICROWAVE RADIATION LEVELS RESULTING FROM MAN-MADE SOURCES IN THE WASHINGTON, D.C., AREA

1. SUMMARY AND RESULTS

During the summer of 1969, mobile radiation monitoring equipment was used to measure man-made radiation levels from 20 Hz to 10 GHz at 10 scattered sites within a 25-mile radius of Washington, D.C. These measurements were made by White Electromagnetics Incorporated under Public Health Service contract CPE-R-69-22. The resulting data were later put into digital form and analyzed. A summation of power densities from narrowband sources was made over four "biologically relevant" portions of the total spectrum measured. The divisions were made on the basis of percent absorption of radiation by the human body (1). Table 1 shows these biologically relevant frequency bands and the absorption percentages. The maximum observed power densities of radiation in each of the bands in the D.C. urban area are summarized in table 2.

Table 1. Relative absorption cross sections of electromagnetic radiation in the human body.

Frequency (MHz)	Maximum absorption (percent)
< 400	< 50
400 - 1,000	50 - 100
1,000 - 3,000	20 - 100
3,000 - 10,000	> 50

Table 2. Maximum observed power density levels in four biologically relevant frequency bands.

Frequency (MHz)	Site	Power density exposure (mW/cm^2)
Less than 400	Holy Cross Hospital	3.9×10^{-4}
400 - 1,000	Montgomery Mall	1.1×10^{-5}
1,000 - 3,000	National Airport	7.7×10^{-3}
3,000 - 10,000	National Airport	1.4×10^{-4}

2. INTRODUCTION AND BACKGROUND

During the last 25 years the energy radiated in the microwave and RF regions for public, military, and commercial purposes has increased by several orders of magnitude. The biological effects of such nonionizing radiation became of concern to the U.S. Public Health Service and resulted in the enactment of Public Law 90-602, the Radiation Control for Health and Safety Act of 1968 (2). Test programs have been conducted to measure power densities from consumer devices emitting nonionizing radiation (3), and many investigators have examined possible harmful effects to life systems exposed to RF and microwave radiation (4,5). This work has included attempts to establish a basis for formulating radiation emission standards for selected products and frequencies.

There are presently no Federal, State, or private standards that apply directly to the situation of public exposure to RF or microwave radiation from high-powered electronic equipment such as broadcast towers or radar installations. There are, however, numerous standards in the U.S. and abroad that are designed to protect microwave oven users from exposure to excessive leakage radiation (6) and that recommend limits on radiation exposure to personnel working in RF or microwave fields (7). For example, the American National Standards Institute has recommended that occupational exposure for frequencies between 10 MHz and 10 GHz not exceed 10 mW/cm^2 for periods of 0.1 hour or longer and that in no circumstance should exposure exceed 1 $mW\text{-}hr/cm^2$ (8).

In the past the military and other organizations have studied the possibly hazardous radiation levels produced by individual radar facilities and high-powered, long-range broadcasting systems (9). Recently, the Bureau of Radiological Health, Public Health Service, has made field measurements of RF levels near FM and TV broadcast towers in the Las Vegas, Nev., area (10). Extensive studies have also been made of ordnance hazards and the electromagnetic compatibility of RF sources. The Electromagnetic Compatibility Analysis Center (ECAC) of Annapolis, Md., maintains a large data base of characteristics and locations of RF emitters in the U.S. (11).

All of the above-mentioned investigations of possible hazards have been made in the immediate locale of individual emitters. To our knowledge, no previous attempts have been made in the U.S. to measure the overall population exposure in an urban environment that results from the myriad broadcast towers, communications links, radar installations, and other sources of RF and microwave radiation typical of a large city. Some crude models exist for calculating such an exposure, but work is just beginning in this area. Several measurements have been made of total man-made electromagnetic noise in a large city (12,13), but these omit all contributions from narrowband sources. This report, then, represents an attempt to examine ambient RF and microwave radiation levels in an urban environment.

3. EXPERIMENTAL PROCEDURES

3.1. MEASUREMENTS

The city of Washington, D.C. may be unusual from the viewpoint of background RF radiation. Besides the normal proliferation of public and commercial emitters, Washington is a center for a host of government and military communication sources.

A summary listing was obtained from ECAC of Annapolis, Maryland, of all emitters with an average output above 10 watts reported to be located within a 50-mile radius of the Washington Monument. The data consisted of 1430 communications sources and 99 radar sites. Types of emitters included AM and FM broadcast facilities, point-to-point communications, experimental research installations, radar navigational aids, ship-to-shore communications, ground-to-air communications, teletype terminals, and police base communications.

Power output of transmitters listed by ECAC ranged from 0.1 kW to a 5000-kW search radar installation. More than 200 of the listings had nominal outputs of 10 kW and above. It should be emphasized that these data included only unclassified sources. It was possible, then, to compare the experimental peaks with the parameters of individual emitters included in the listing and, in some instances, to predict the measured intensities.

During this project, personnel of the Division of Electronic Products and White Electromagnetics, Inc., monitored radiation from 20 Hz to 10 GHz at 10 locations distributed around the D.C. area. The locations were chosen with preference given to high-density population areas near high-powered electromagnetic energy sources. Table 3 lists the site, the date of monitoring, the hours of monitoring, and the number of sweeps through the spectrum. The map in figure 1 shows the location of the 10 monitoring sites. A description of each site is included in appendix A. It should be noted that seven of the 10 sites were surveyed during normal working hours; i.e., 8:00 A.M. to 5:00 P.M. Two of the sites were surveyed during the evening as well as during normal working hours. Finally, one of the sites was tested for a total period of 24 continuous hours to obtain baseline data independent of time of day.

Table 3. Sites monitored for background radiation.

Site	Date	Hours monitored	Spectrum scans
1. Holy Cross Hospital	7/18/69	1015-1415	10
2. Montgomery Mall Shopping Center	6/17/69	1300-1700	10
3. Cameron Station	7/24/69	1200-1600	12.5
4. Andrews AFB	7/25/69	1045-1545	7
5. Washington Mall	7/19/69	0700-1900	37
6. Brentwood Park	7/31/69	1250-1550	13
7. Sibley Memorial Hospital	8/7/69	1230-1630	13
8. Duval Senior High School	8/8/69	1100-1500	12
9. National Airport	8/12/69	1100-2300	30
10. Darnestown, Maryland	8/27/69-8/28/69	1030-1030	67

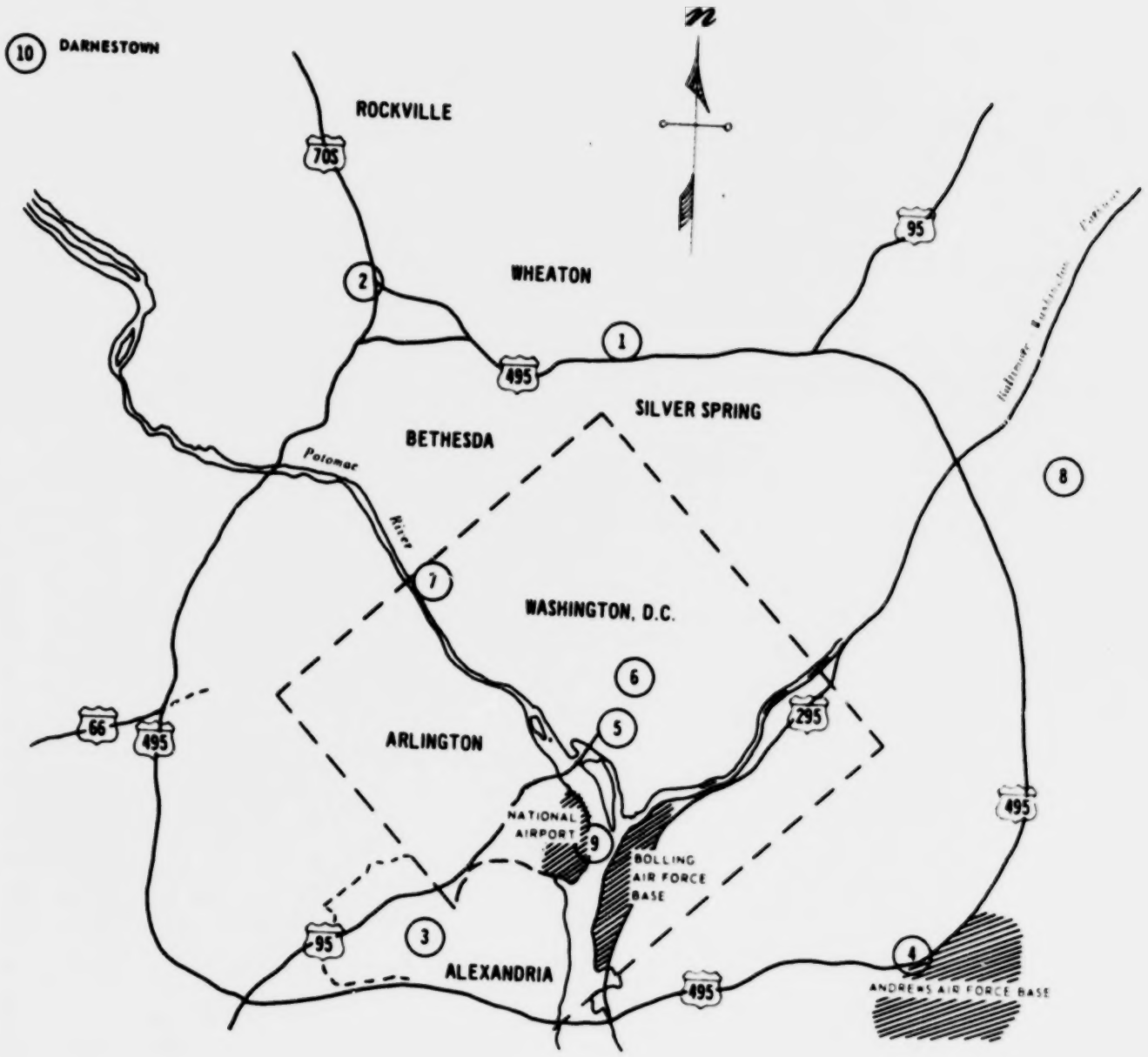

Figure 1. Map of Washington, D.C., showing sites monitored.

Data were acquired through the use of automatic equipment mounted in a van equipped with an independent 1-kW a.c. generator. The apparatus consisted of a White Electromagnetics, Inc., Automatic Spectrum Display and Signal Recognition System, Models 130A and 140A. These units scanned and plotted on chart recorders radiated intercepted signal amplitudes over the frequency range of 20 Hz to 10,000 MHz in 22 continuous bands. The equipment included a fully automated and integrated spectrum-scanning and plotting system controlled by a selectable, stored logic master which controlled the operations of input sensor,receiver selection, receiver band switching, and band output switching. The outputs included an X-Y plotter with data displayed on a calibrated multiband graph and an audio monitoring unit. A further description of the components and their specifications along with descriptions of the antennas is contained in appendix B. A block diagram of the instrumentation is also shown in appendix B.

During the monitoring, antenna asimuth location was referenced to magnetic north and measurements were made in each of the quadrants. The spectrum covered was scanned at a rate of roughly 1 minute per octave.

Figure 2 represents a typical data chart of measurements taken from 20 Hz to 1 GHz. The red or upper line on each data sheet was produced by the peak channel of the system. This channel was driven by a peak-voltage-detecting device which had a rise time of 5 nanoseconds and was, therefore, capable of capturing very short duration events such as ignition noise and other forms of impulsive or broadband energy. In addition, this channel was sensitive to narrowband energy (i.e., signal sources of small bandwidth compared to that of the receivers) and responded to continuous-wave level (carriers) as the system scanned through its frequency range.

The green or lower line on the data sheet was produced by the average channel of the system. It was driven by an average-detecting device which responded to the RMS value of only the received narrowband signals. This channel, however, was not calibrated and was used to identify narrowband signals when compared to the peak channel. Thus, only the narrowband signals of the peak channel detector were considered in the analysis of the data.

Figure 3 is a typical data sheet for measurements ranging from 1.0 GHz to 10 GHz. In this case only the peak detector was used, and operator discretion was necessary to determine whether the signals were broadband or narrowband. The raw data then consisted of peak-voltage values of received RF signal sources. The gray areas on each data sheet represent the frequency overlap between bands. Signals appearing in these areas were ignored because they appeared in the next or previous band. The number written in each band of the data sheet is an indication of the amount of attenuation, in dB, used in that band during the spectrum scan. If an "0" appeared on the band, no attenuation was used.

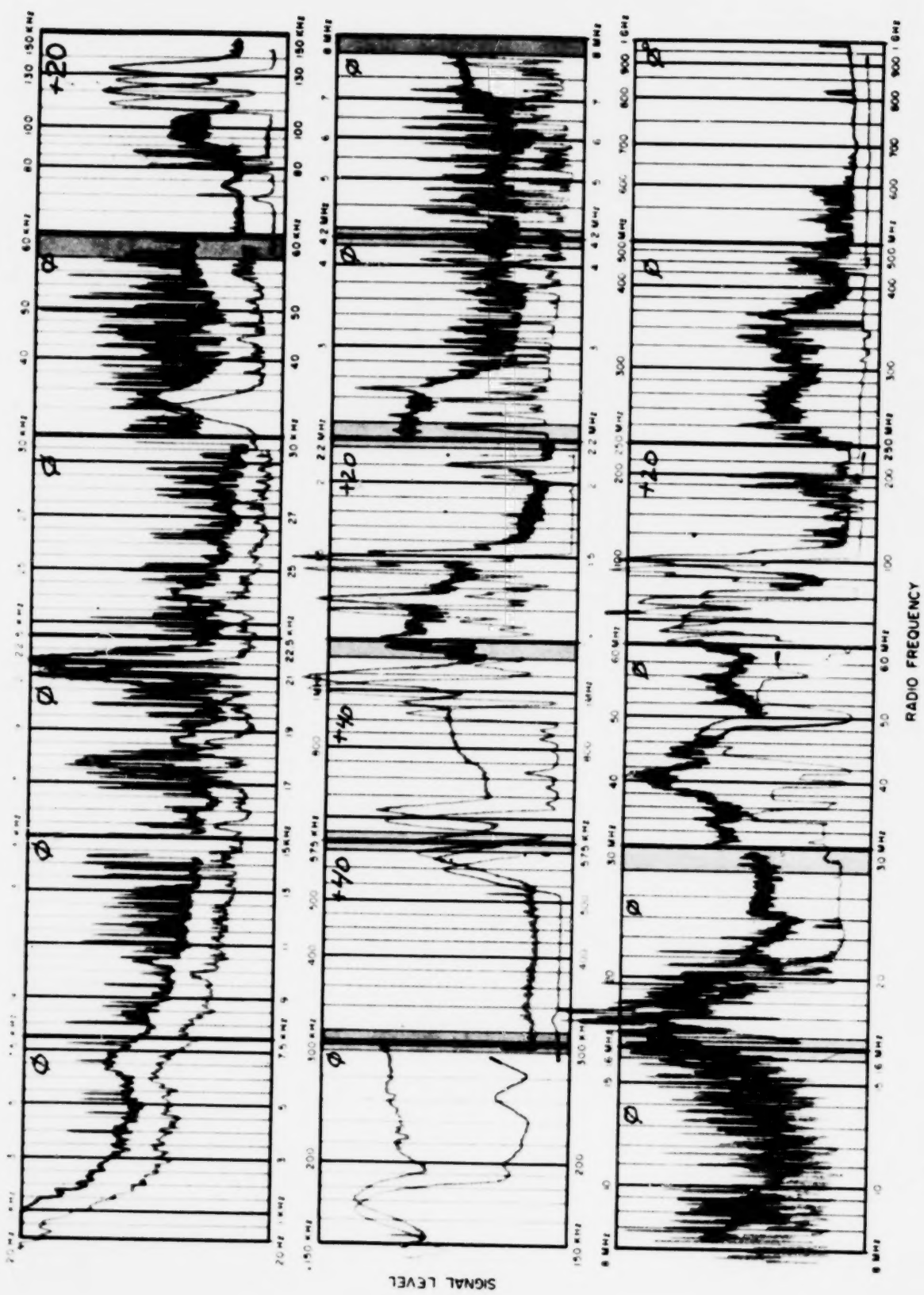

Figure 2. Typical data chart for measurements ranging from 20 Hz to 1 GHz.
(Site 5, Washington Mall)

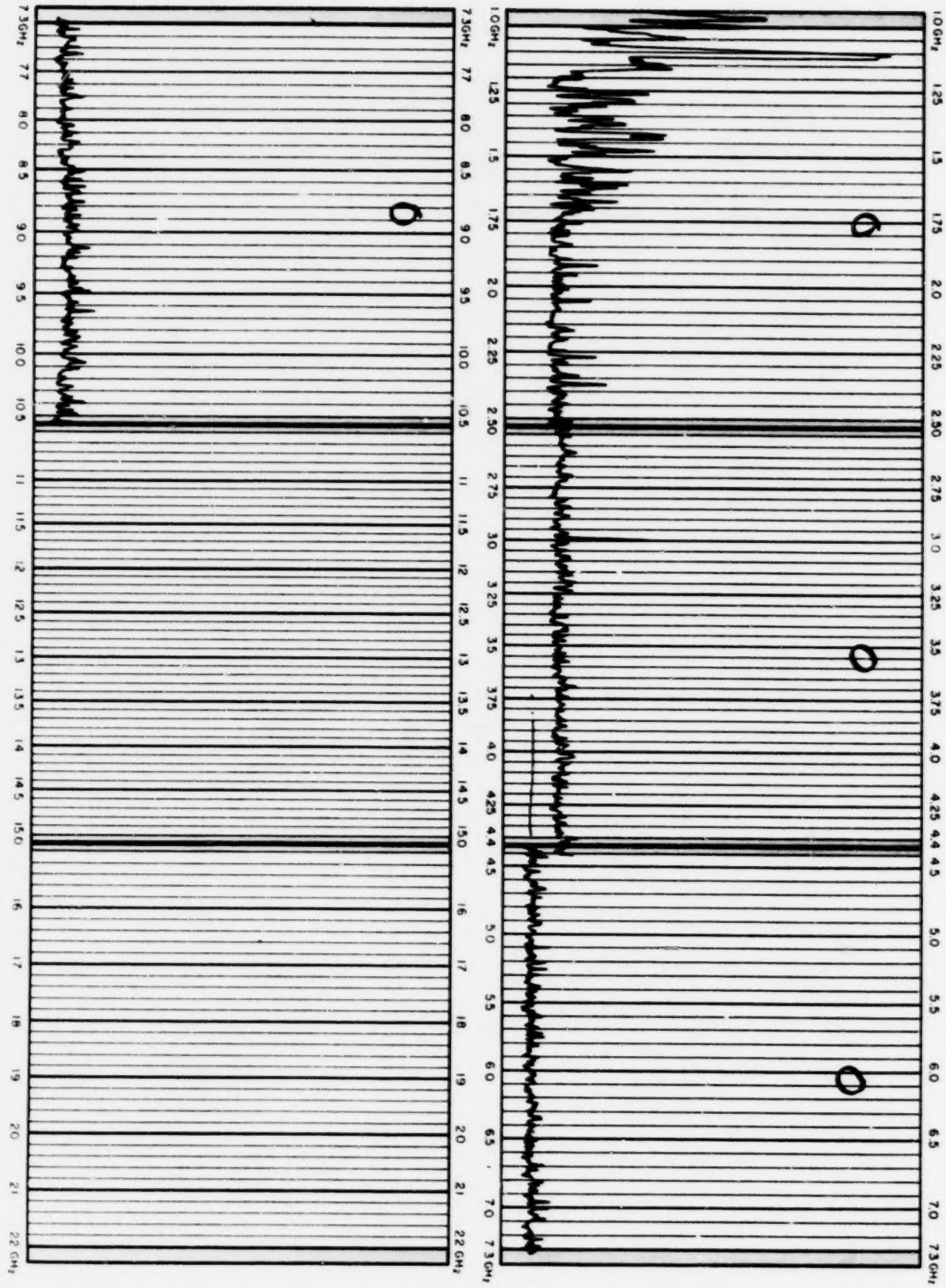

Figure 3. Typical data chart for measurements ranging from 1.0 to 10 GHz.
(Site 5, Washington Mall)

Calibration curves were made at approximately half the sites. Each receiver was tested over its frequency range with a broadband pulse generator. The calibration traces were made in decibels relative to 1 microvolt for a broadband pulse. Conversion factors from broadband to narrowband calibrations were determined in decibels for each receiver's 3-dB bandwidth relative to a 1-MHz bandwidth. Antenna factors for each antenna were determined to convert the signals into terms of electric field strength in dB relative to 1 $\mu V/m$.

3.2 DATA ANALYSIS

The raw background data for the 10 sites were delivered in the form of 250 X-Y plots similar to figures 2 and 3. The procedures used for analysis are described below.

The information contained in the charts was put into digital form for computer analysis. Each curve was traced by means of a Gerber PF 10B Coordinate Digitizer, and each peak representing a narrowband signal was specified by three (x,y) coordinates. The data were then placed on coded punched cards. Four computer programs were written to arrive at power densities averaged over the number of spectrum scans for each survey site.

The program EMBAK grouped data from all the charts of one site into specific frequency bands corresponding to the boxes on the typical chart. It then adjusted each data point to fall between 0 and 10,000. These operations were applied for each frequency "box." The program VARMIT dealt with the calibration traces for both intensity and frequency. The calibration data points were fitted to a fifth order polynomical.

The program AVEBK treated each frequency "box" individually. It first identified each narrowband peak for one chart. The peak voltages were then fitted to the calibration curves. Proper attenuation factors, cable loss values, and antenna factors in terms of dB were added to each peak, and the peak heights were then converted into terms of power density in units of mW/cm^2. Finally, the heights of peak power were arithmetically averaged over the number of spectrum scans made at an individual site.

4. EXPERIMENTAL ACCURACY

The accuracy of the data was influenced by several factors. First, the equipment specifications indicated that the accuracy of the receiving and display system, including the plotter, could be set to about ±3 dB. Second, the antennas used in the experiment were all polarization dependent to some extent. One could assume that all measurements were taken in the far field of the emitters and, thus, that the electric field could be projected into some combination of vertical and horizontal polarization. For example, the 41-inch rod antenna used for all AM broadcast and high-frequency communications measurements responded only to vertical polarization, and the broadband dipole used for all FM, VHF, and UHF measurements responded only to horizontal polarization. These directions, however, correspond to the typical polarizations of the transmitters, and a maximum error can be estimated at around ±6 dB.

Another influencing factor is the variation of the received signals. During the operations of the program AVEBK, a constant check was made of the percent deviation of individual peak heights from their average. The maximum variation in intensities, approximately ±6 dB, occurred for a pulsed radar installation. The cause of such a diversity of received signals can be attributed to the modulation, the duty factors, and the relative direction of the emitting sources at the time of reception. For example, if the receivers were monitoring a pulsed signal only during its dead time, no intensity would be detected for that particular frequency scan. If the monitoring coincided with the on-time, a maximum would be detected. A large number of scans would be needed to arrive at a good average. The typical variation for the received signals was about ±3 dB.

The final factor affecting the accuracy of the experiment was the diurnal variation of signal strength. It is possible that the 1 day or 8 hours measured at a particular monitoring site was only grossly representative of the normal average RF exposures at the location. However, since most of the power densities detected originated from commercial broadcast equipment which operated daily and emitted the most power during working hours, the variation of total power densities from day to day would be negligible. The only noticeable variation of signals came in the increased use of the amateur "ham" radio bands at night. These level changes were insignificant. It should also be noted that all broadband noise, whether man-made, atmospheric, galactic, etc., has been considered insignificant compared to the levels of the narrowband sources and, therefore, has been ignored.

Considering the influences described above, the experimental results can be considered accurate to within ±15 dB.

5. RESULTS

The results of the first three computer programs consisted of a listing of frequencies and the peak power densities of specific narrowband emitters averaged over a number of spectrum scans throughout the day at a given site.

True average values of power densities are functions of the modulation and duty factors of the signal source. These would fall anywhere from 2 to 4 dB below the peak values for AM or FM emitters to as much as 30 dB or more below for pulsed equipment such as radar installations. The peak levels,thus,represent a worst-possible case.

The test results indicate that the vast majority of the intensity measured was emitted in the commercial broadcast bands. Appendix C lists three highest data peaks in each "box" from the test site at Washington Mall. The average number of received signals per frequency box was approximately 7.0. This listing is typical of the number of signals occupying the spectrum and their intensities in the 250 spectrum scans of this experiment. The accuracy of these intensities is within that discussed above; the accuracy of the frequency location of each peak is listed in appendix B. The FCC frequency allocations have been included in the table to aid in identification of the type of sources.

In the final program, LINDA, the frequency and peak power density level were relisted for each data peak. The levels were summed arithmetically over four relevant frequency bands, and a summation was made over the entire frequency range of 20 Hz to 10 GHz. A summation was also made over the commercial broadcast bands, AM, FM, VHF, and UHF, for each of the 10 sites. The results of these operations are shown in appendix D. In this summing operation each power term was directly proportional to the square of the associated electric field. Theoretically, the true instantaneous total power density should include the cross terms that arise from the squaring of a sum. On the average, however, these products will be very small, and since one peak usually dominates in each band, the cross terms will also be negligible compared to the square of the dominant signal at the given instant of the measurement.

The highest intensity was measured at National Airport where a peak level of 7.7×10^{-3} mW/cm^2 at 2.9 GHz was noted. This was attributed to one of the high-powered, pulsed, search-radar installations present in the vicinity of the airport. The low duty cycle of such an installation would indicate an *average* power density around 7×10^{-6} mW/cm^2 at the actual test site.

The next highest value, which occurred in the AM frequency range, was measured at Holy Cross Hospital near the Capital Beltway, I-495. A peak power density of 2.4×10^{-4} mW/cm^2 was measured at a frequency of 1.1 MHz which would fall within 4 dB of the average. This frequency corresponds to the 1-kW AM tower of WQMR which is located approximately 300 meters from the test site. The measured power density is in general agreement with the predicted value, which is calculated as follows:

$$P_D = \frac{PG}{4\pi R^2}$$

where P_D = power density at distance R from antenna

and G = gain of antenna = 1.64

Therefore,
$$P_D = \frac{(1\ \text{kW})(1.64)}{4\pi(300\ \text{m})^2} = \frac{(10^3\ \text{W})(1.64)}{4\pi(90000\ \text{m}^2)}$$
$$= 1.4 \times 10^{-4}\ \text{mW/cm}^2$$

The 1-kW output of WQMR, when compared to 50-kW AM stations and MW radar sites, is small. The high intensity measured was a result of the extremely close proximity to the test site. In the case of the other sites, high-powered AM or FM transmitters were more than 1 mile from the test site. Thus, a relatively low-powered source which is directional and/or located in close proximity to a residential area can cause a higher exposure than major antennas which are more isolated.

The two readings described above overwhelmed all other signals in the sum at their particular sites. These sites yielded the highest total power densities of the experiment. The total power density for National Airport was 7.9×10^{-3} mW/cm^2, and the total for Holy Cross Hospital was 3.9×10^{-4} mW/cm^2.

6. CONCLUSIONS AND RECOMMENDATIONS

The peak ambient radiation originating from man-made RF sources at the 10 sites monitored in the Washington, D.C., area approached a maximum of 10^{-2} mW/cm^2. This power density may be considered accurate to within 15 dB. If high-powered, low-duty-cycle, pulsed radar signals are considered abnormal and excluded from the totals, the maximum was more nearly 10^{-3} mW/cm^2; and if one is concerned only with average exposure, the maximum would fall even lower. The average background thus is at least two to three orders of magnitude less than any published U.S. recommendation for exposure to RF radiation. Almost the entire power density measured at the monitored sited could be attributed to individual or a combination of commercial broadcasting and high-powered radar installations in close proximity to the test site (i.e., within 1 mile).

On the basis of these results, it is recommended that no further broadband environmental surveys be carried out at this time unless prior calculations indicate their need. Individual AM and FM radio and VHF, UHF, and radar transmitters, however, should be closely monitored to determine exposure levels at populated sites in proximate areas.

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APPENDIX A

DESCRIPTION OF TEST SITES

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APPENDIX A

DESCRIPTION OF TEST SITES

1. HOLY CROSS HOSPITAL

Holy Cross Hospital is a 344-bed medical facility located just off Forest Glen Road in Silver Spring, Md. The hospital employs approximately 500 persons and occupies a 10.4-acre site several hundred yards north of I-495 (the Capital Beltway).

A self-contained emergency power generating station, capable of putting out a total of 375 kW of electrical energy, is maintained adjacent to the south side of the building. A test site was selected on the east side of this generating station.

2. MONTGOMERY MALL

Montgomery Mall is one of the newest and largest shopping centers in the Washington metropolitan area. It consists of a completely enclosed shopping area containing 60 stores and shops and serves approximately 15,000 customers during weekday hours. The Mall is located 1 mile west of I-270 on Democracy Boulevard in Bethesda, Md., and covers an area of 55 acres, including parking facilities.

The test site was located in a parking area approximately 100 yards from the south entrance to the Sears, Roebuck & Company store, which is in the southeast corner of the Mall. Pedestrian traffic in the immediate area of the site was fairly light, as was vehicular traffic.

3. CAMERON STATION

Cameron Station is located in a semi-industrial area of southwest Alexandria, Va. Several high-rise apartment buildings are situated in the area of the site, but the majority of construction in the immediate vicinity is zoned for small business and service establishments.

The Cameron Station Quartermaster Depot is also located here and serves as the official purchasing agency for the Washington, D.C., Military District of the U. S. Army.

The test site was located in a parking lot at the southwest corner of Duke and Pickett Streets.

4. ANDREWS AIR FORCE BASE

Andrews Air Force Base is located in Prince Georges County, Md., just off the southeast corridor of the Capital Beltway (I-495) and approximately 11 miles from downtown Washington, D.C. The base covers an area of 4250 acres and employs over 15,000 military and civilian personnel.

Andrews' mission is to supply all operational and logistic support to military personnel in the greater Washington, D.C., vicinity and also to provide associated training to meet current performance standards.

Thirty tenant military units are stationed at Andrews AFB, including the Air Force System Command, the Naval Air Reserve Facility, and the Naval and Marine Reserve Training Facility.

The test site was located in the Andrews Manor Shopping Center, across from the main gate at the Air Force Base.

5. WASHINGTON MALL

Washington Mall is an open, grassy area extending from the Capital Building to the Washington Monument. The numerous government offices and tourist attractions surrounding the Mall render it an area of very high pedestrian traffic.

The test site was located on the Mall, across from the National Gallery of Art, on the northwest corner of the intersection of Sixth and Adams Streets, N.W.

6. BRENTWOOD PARK

Brentwood Park is a rambling residential area in northeast Washington, D.C., surrounded mainly by lower-middle class dwelling units and apartment projects. A short distance away, in the Florida Avenue markets, are many of the warehouses and distribution centers of the city's food industry.

The test site was located in an open field on the Gallaudet College campus, on Florida Avenue at 7th Street, N.E.

7. SIBLEY MEMORIAL HOSPITAL

Sibley Memorial Hospital is located just inside the Washington, D.C., line on MacArthur Boulevard, N.W. The hospital is situated less than a quarter of a mile from the Potomac River in a semiresidential area. Several radio and television transmitting stations are located within a 2-mile radius of Sibley Hospital.

The test site was located on a small hill on the northwest side of the hospital.

8. DUVAL SENIOR HIGH SCHOOL

DuVal Senior High School is located at Glenn Dale and Telegraph Roads in Prince Georges County, Md., near the Goddard Space Flight Center (NASA) in Greenbelt, Md.

This area is approximately 8 miles from downtown Washington, D.C., and is almost exclusively a residential area.

The test site was located in the north parking lot area of the high school.

9. WASHINGTON NATIONAL AIRPORT

Washington National Airport is the major airline terminal serving the surrounding metropolitan area and handles the takeoffs and landings of anywhere from 350 to 550 aircraft daily. In the month of July 1969 alone, nearly 1.5 million commercial passengers passed through National Airport enroute to destinations all over the world.

Located at the airport is a wide range of communications transmitters, as well as Flight Control and Ground Control Approach radar systems. National Airport is located in Arlington County, Va., on the George Washington Memorial Parkway, just outside of Alexandria, Va., and directly south across the Potomac from the Jefferson Memorial.

The test site was located in a parking area reserved for the Diplomatic Corps.

10. DARNESTOWN, MD.

Darnestown, Md., is a small rural community approximately 9 miles west of Rockville, Md., on Route #28, 20 miles northwest of Washington, D.C. Darnestown has no industry of its own, but is surrounded by farming areas and several residential developments. Four miles east of the town on Route #28 is an Army installation housing a NIKE/AJAX anti-aircraft system, which includes air search and guidance radars.

The actual site was at the house of Mr. Donald R. J. White on Springfield Drive, which intersects Route #112 about 1 mile south of Darnestown.

APPENDIX B

EQUIPMENT SPECIFICATIONS

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APPENDIX B

EQUIPMENT SPECIFICATIONS

1. Bandwidth and frequency range of receivers

Receivers	Bandwidth	Frequency range
Fairchild EMC-10	250 Hz	20 Hz - 30kHz
CEI - 302	3 kHz	30 kHz - 150 kHz
Stoddard 390	10 kHz	150 kHz - 30 MHz
CEI S 30	2 MHz	30 MHz - 250 MHz
LEI SUT 1000	4 MHz	250 MHz - 1 GHz
EMA 910	5 MHz	1 GHz - 10 GHz

2. Frequency range of antennae

Antennae	Frequency range
Fairchild ALP-10 Loop	20 Hz - 30 kHz
Empire LG-105 Loop	30 kHz-150 kHz
Stoddart 92198 41" Rod	150 kHz - 30 MHz
Empire MD 105 Broadload Dipole	30 MHz - 250 MHz
Stoddart 93490-1 Conical,Log Spiral	250 MHz - 1.0 GHz
Stoddart 93491-1 Conical,Log Spiral	1.0 GHz - 10.0 GHz

3. Specifications for System 130A

   a. Spectrum Coverage

      20 Hz to 1,000 MHz (Model 130A-20H) in 18 bands in 26 continuous octaves.

      Other spectrum coverage ranges available.

b. Frequency Accuracy

Multiband: ±2% of receiver dial reading.

Singleband: ±1% of receiver dial reading.

c. Sensitivity

Nominal: 25 dB μV/MHz or -135 dBm at VLF to 0 dB μV/MHz or -100 dBm at UHF.

With correlator Model 3360A: -15 to +10 dB μV/MHz or -150 dBm to -115 dBm

d. Amplitude Accuracy

Multiband: ±2 dB of calibration source with peak detector.

Singleband: ±1 dB of calibration source with peak detector.

Repeatability and drift: ±1 dB after 30-minute warmup.

e. Dynamic Range

Broadband: 40 dB to 60 dB, depending upon band in use.

Narrowband: 45 dB to 70 dB, depending upon band in use.

f. Measurement Range

120 dB to 140 dB or 80 dB RF attenuator plus 40 to 60 dB dynamic range.

Automatic preselected RF attenuation switched in/out on a per-band basis during scanning with Model 3360A

Automatic spectrum attenuation and plotting up to 150 dB over frequency range of 20 Hz to 1,000 MHz, Model 3390A.

g. Detector Functions

Peak Detector: 5-nanosecond rise time; floating hold time and dump interval, depending on X-Y plotter amplitude excursion.

Peak plotter response within 1 dB for any signal from CW to single-shot pulse for 90 percent of pulse energy within IF bandwidth.

h. Calibration

Impulse Generator: 10 to 91 dB μV/MHz in 1 dB steps.

4. Specifications for System 140A

a. Spectrum Coverage

1.0 GHz to 10.5 GHz in 4 bands in 3.4 continuous octaves.

b. Frequency Accuracy

Multiband: ±2% of receiver dial reading.

Singleband: ±1% of receiver dial reading.

c. Sensitivity

Nominal: 25 db μV/MHz or -100 dBm.

d. Amplitude Accuracy

Multiband: ±2 dB of calibration source with peak detector.

Singleband: ±1 dB of calibration source with peak detector.

Repeatability and drift: ±1 dB after 30-minute warmup.

e. Dynamic Range

Broadband: 40 dB to 60 dB, depending upon band in use.

Narrowband: 45 dB to 70 dB, depending upon band in use.

f. Measurement Range

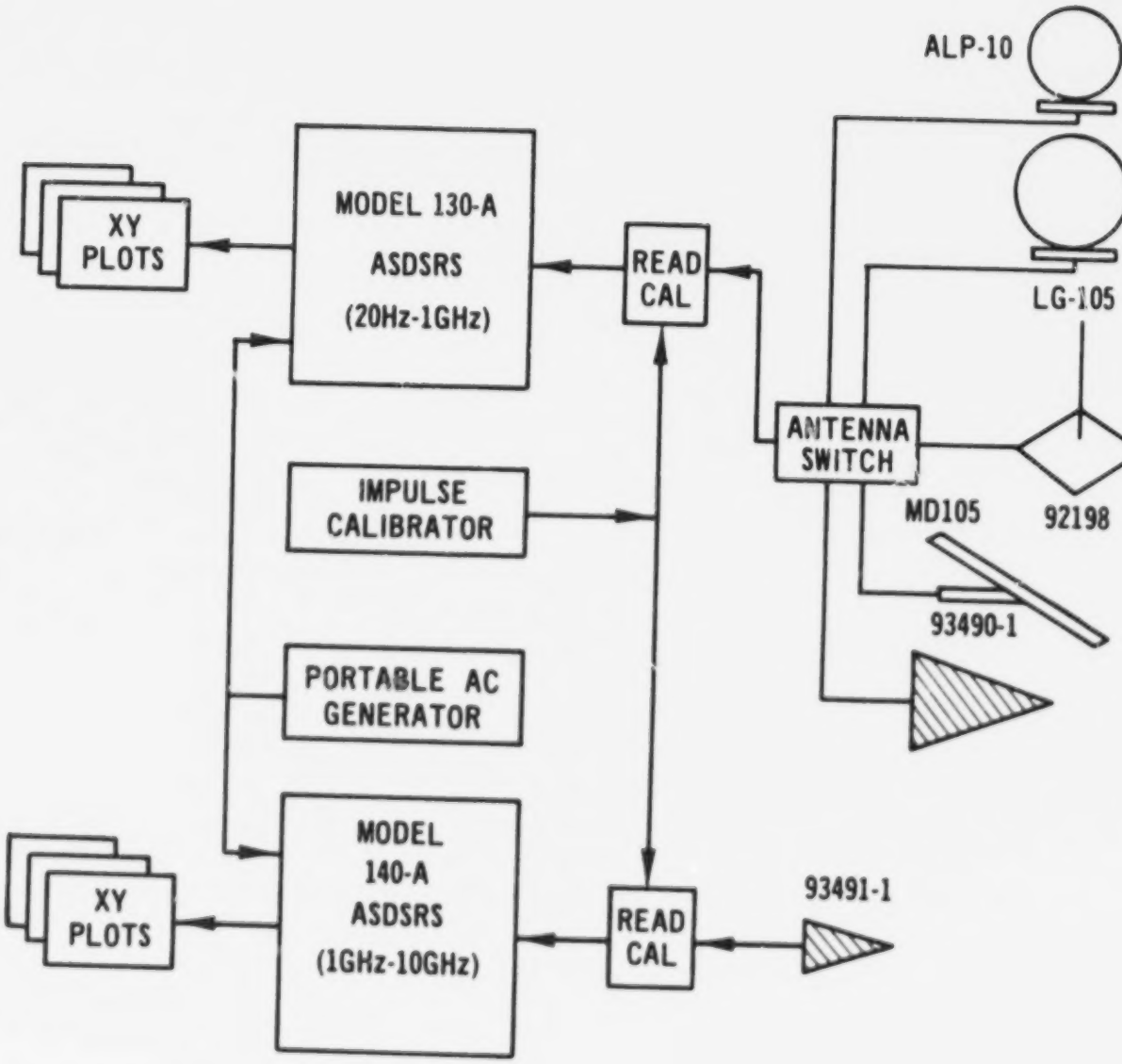
120 dB to 140 dB or 80 dB RF attenuator plus 40 to 60 dB dynamic range.

g. Detector Functions

Peak Detector: 5-nanosecond rise time; floating hold time and dump interval depending on X-Y plotter amplitude excursion. Peak plotter response within 1 dB for any signal from CW to single-shot pulse for 90% of pulse energy within IF bandwidth.

h. Calibration

Impulse Generator: 60 to 70 dB μV/MHz in 1 dB steps.



Mobile instrumentation van block diagram.

APPENDIX C

READINGS FROM SITE NUMBER 5, WASHINGTON MALL

APPENDIX C

READINGS FROM SITE NUMBER 5, WASHINGTON MALL

Box no.	Frequency (KHz)	Power density (mW/cm^2)	FCC allocations	
			Frequency (KHz)	Service
Box 1	0.02 - 7.5	Below receiver sensitivity	Below 10.0	Not allocated
Box 2	7.5 - 15.0	Below receiver sensitivity	10.00 - 14.00	Radio navigation Radio location
Box 3	15.0 - 22.5		14.00 - 19.95	Fixed Maritime mobile
	18	2.9×10^{-12}		
	21	1.8×10^{-10}	19.95 - 20.05	Standard frequency
	22	8.2×10^{-10}		
Box 4	22.5 - 30.0		20.05 - 70.00	Fixed Maritime mobile
	27	9.5×10^{-13}		
	28	1.7×10^{-12}		
	29	5.6×10^{-13}		
Box 5	30.0 - 60.0		70.00 - 90.00	Fixed Maritime mobile Maritime radio navigation Radio location
	35	8.5×10^{-8}		
	38	1.2×10^{-8}		
	58	6.3×10^{-12}		
Box 6	60.0 - 150.0		90.00 - 110.0	Radio navigation Fixed Maritime mobile
	86	6.4×10^{-9}		
	120	3.6×10^{-8}		
	130	2.0×10^{-8}	110.0 - 130.0	Fixed Maritime mobile Maritime radio navigation Radio location
Box 7	150.0 - 300.0		130.0 --160.0	Fixed Maritime mobile
	170	1.0×10^{-8}	160.0 - 200.0	Fixed
	180	2.7×10^{-8}	200.0 - 285.0	Aeronautical radio navigation Aeronautical mobile
	190	5.9×10^{-8}		
			285.0 - 325.0	Maritime radio navigation (radio beacons) Aeronautical radio navigation

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READINGS FROM SITE NUMBER 5, WASHINGTON MALL (continued)

Box no.	Frequency (KHz)	Power density (mW/cm^2)	FCC allocations	
			Frequency (KHz)	Service
Box 8	300.0 - 575.0		325.0 - 405.0	Aeronautical radio navigation
	340	3.0×10^{-8}		Aeronautical mobile
	580	1.3×10^{-6}	405.0 - 415.0	Maritime radio navigation (radio direction-finding)
				Aeronautical radio navigation
				Aeronautical mobile
			415.0 - 490.0	Maritime mobile(radiotelegraphy only)
			490.0 - 510.0	Mobile (distress and calling)
			510.0 - 525.0	Mobile
				Aeronautical radio navigation
			525.0 - 535.0	Mobile
				Broadcasting
				Aeronautical radio navigation
Box 9	575.0 - 1150		535.0 - 1605	Broadcasting
	650	8.2×10^{-7}		
	740	1.3×10^{-6}		
	990	1.9×10^{-6}		
Box 10	1150 - 2200		1605 - 1800	Fixed
	1400	1.4×10^{-6}		Mobile
	1500	6.8×10^{-6}		Aeronautical radio navigation
	1600	9.5×10^{-6}		Radio location
			1800 - 2000	Amateur
				Fixed
				Mobile except aeronautical
				Radio navigation
			2000 - 2065	Fixed
				Mobile

READINGS FROM SITE NUMBER 5, WASHINGTON MALL (continued)

Box no.	Frequency (KHz)	Power density (mW/cm^2)	FCC allocations: Frequency (KHz)	FCC allocations: Service
Box 10 (cont'd)	1150 - 2200 (cont'd)		2065 - 2107	Maritime mobile(radiotelegraphy only)
			2107 - 2170	Fixed Mobile
			2170 - 2194	Mobile (distress and calling)
Box 11	2200 - 4200		2194 - 2300	Fixed Mobile
	2500 2600 4200	3.3×10^{-12} 5.1×10^{-12} 2.2×10^{-12}	2300 - 2495	Fixed Mobile Broadcasting
			2495 - 2505	Standard frequency
			2505 - 2850	Fixed Mobile
			2850 - 3025	Aeronautical mobile
	Frequency (MHz)		Frequency (MHz)	
	2.2 - 4.2 (cont'd)		3.025 - 3.155	Aeronautical mobile
			3.155 - 3.200	Fixed Mobile except aeronautical
			3.200 - 3.400	Fixed Mobile except aeronautical Broadcasting
			3.400 - 3.500	Aeronautical mobile
			3.500 - 4.000	Amateur Fixed Mobile except aeronautical
			4.000 - 4.063	Fixed
Box 12	4.20 - 8.00		4.063 - 4.438	Maritime mobile
	4.6 7.2 7.3	1.4×10^{-11} 1.3×10^{-11} 2.1×10^{-11}	4.438 - 4.650	Fixed Mobile except aeronautical

READINGS FROM SITE NUMBER 5, WASHINGTON MALL (continued)

Box no.	Frequency (Mlz)	Power density (mW/cm^2)	FCC allocations	
			Frequency (Mhz)	Service
Box 12 (cont'd)	4.20 - 8.00 (cont'd)		4.650 - 4.700	Aeronautical mobile
			4.700 - 4.750	Aeronautical mobile
			4.750 - 4.850	Fixed Broadcasting
			4.850 - 4.995	Fixed Land mobile Broadcasting
			4.995 - 5.005	Standard frequency
			5.005 - 5.060	Fixed Broadcasting
			5.060 - 5.250	Fixed
			5.250 - 5.450	Fixed Land mobile
			5.450 - 5.680	Aeronautical mobile
			5.680 - 5.730	Aeronautical mobile
			5.730 - 5.950	Fixed
			5.950 - 6.200	Broadcasting
			6.200 - 6.525	Maritime mobile
			6.525 - 6.685	Aeronautical mobile
			6.685 - 6.765	Aeronautical mobile
			6.765 - 7.000	Fixed
			7.000 - 7.300	Amateur
			7.300 - 8.195	Fixed
Box 13	8.00 - 16.00		8.195 - 8.815	Maritime mobile
	9.5	1.7×10^{-10}	8.815 - 8.965	Aeronautical mobile
	9.7	2.9×10^{-10}	8.965 - 9.040	Aeronautical mobile
	12	8.5×10^{-11}	9.040 - 9.500	Fixed
			9.500 - 9.775	Broadcasting
			9.775 - 9.995	Fixed
			9.995 -10.005	Standard frequency
			10.005 -10.10	Aeronautical mobile

READINGS FROM SITE NUMBER 5, WASHINGTON MALL (continued)

Box no.	Frequency (MHz)	Power density (mW/cm^2)	FCC allocations	
			Frequency (MHz)	Service
Box 13 (cont'd)	8.00 - 16.00 (cont'd)		10.10 - 11.175	Fixed
			11.175 - 11.275	Aeronautical mobile
			11.275 - 11.40	Aeronautical mobile
			11.40 - 11.70	Fixed
			11.70 - 11.975	Broadcasting
			11.975 - 12.33	Fixed
			12.33 - 13.20	Maritime mobile
			13.20 - 13.26	Aeronautical mobile
			13.26 - 13.36	Aeronautical mobile
			13.36 - 14.00	Fixed
			14.00 - 14.35	Amateur
			14.35 - 14.99	Fixed
			14.99 - 15.01	Standard frequency
			15.01 - 15.10	Aeronautical mobile
			15.10 - 15.45	Broadcasting
			15.45 - 15.762	Fixed
			15.762 - 15.768	Fixed Space research
Box 14	16.0 - 30.0		15.768 - 16.46	Fixed
	17	1.9×10^{-9}	16.46 - 17.36	Maritime mobile
	18	1.3×10^{-9}	17.36 - 17.70	Fixed
	19	6.3×10^{-10}	17.70 - 17.90	Broadcasting
			17.90 - 17.97	Aeronautical mobile
			17.97 - 18.03	Aeronautical mobile
			18.03 - 18.036	Fixed Space research
			18.036 - 19.99	Fixed
			19.99 - 20.01	Standard frequency
			20.01 - 21.00	Fixed
			21.00 - 21.45	Amateur

READINGS FROM SITE NUMBER 5, WASHINGTON MALL (continued)

Box no.	Frequency (MHz)	Power density (mW/cm^2)	FCC allocations	
			Frequency (MHz)	Service
Box 14 (cont'd)	16.0 - 30.0 (cont'd)		21.45 - 21.75	Broadcasting
			21.75 - 21.85	Fixed
			21.85 - 22.00	Aeronautical fixed Aeronautical mobile
			22.00 - 22.72	Maritime mobile
			22.72 - 23.20	Fixed
			23.20 - 23.35	Aeronautical fixed Aeronautical mobile
			23.35 - 24.99	Fixed Land mobile
			24.99 - 25.01	Standard frequency
			25.01 - 25.07	Fixed Mobile except aeronautical
			25.07 - 25.11	Maritime mobile
			25.11 - 25.60	Fixed Mobile except aeronautical
			25.60 - 26.10	Broadcasting
			26.10 - 27.50	Fixed Mobile except aeronautical
			27.50 - 28.00	Meteorological aids Fixed Mobile
			28.00 - 29.70	Amateur
Box 15	30.0 - 60.0		29.70 - 30.005	Fixed Mobile
	46	3.0×10^{-11}	30.005 - 30.01	Fixed Mobile Space research Space (satellite identification)
	47	1.1×10^{-11}		
	49	1.4×10^{-11}		
			30.01 - 37.75	Fixed Mobile

READINGS FROM SITE NUMBER 5, WASHINGTON MALL (continued)

Box no.	Frequency (MHz)	Power density (mW/cm^2)	FCC allocations	
			Frequency (MHz)	Service
Box 15 (cont'd)	30.0 - 60.0 (cont'd)		37.75 - 38.25	Fixed Mobile Radio astronomy
			38.25 - 50.00	Fixed Mobile
			50.00 - 54.00	Amateur
			54.00 - 73.00	Fixed Mobile Broadcasting
Box 16	60.0 - 250.0			
	63	1.8×10^{-8}	73.00 - 74.60	Radio astronomy
	68	1.4×10^{-8}		
	72	1.7×10^{-8}	74.60 - 75.40	Aeronautical radio navigation
			75.40 - 88.00	Fixed Mobile Broadcasting
			88.00 - 108.0	Broadcasting
			108.0 - 117.975	Aeronautical radio navigation
			117.975 - 132.0	Aeronautical mobile
			132.0 - 136.0	Fixed Mobile
			136.0 - 137.0	Space research(telemetering and tracking)
			137.0 - 138.0	Meteorological-satellite Space research(telemetering and tracking) Space (telemetering and tracking)
			138.0 - 143.6	Fixed Mobile Radio location
			143.6 - 143.65	Fixed Mobile Space research(telemetering and tracking) Radio location

READINGS FROM SITE NUMBER 5, WASHINGTON MALL (continued)

Box no.	Frequency (MHz)	Power density (mW/cm^2)	FCC allocations	
			Frequency (MHz)	Service
Box 16 (cont'd)	60.0 - 250.0 (cont'd)		143.65 - 144.0	Fixed Mobile Radio location
			144.0 - 148.0	Amateur
			148.0 - 149.9	Fixed Mobile
			149.9 - 150.05	Radio navigation-satellite
			150.05 - 174.0	Fixed Mobile
			174.0 - 216.0	Fixed Mobile Broadcasting
			216.0 - 220.0	Fixed Mobile Radio location
			220.0 - 225.0	Amateur Radio location
			225.0 - 267.0	Fixed Mobile
			267.0 - 272.0	Fixed Mobile Space (telemetering)
			272.0 - 273.0	Fixed Mobile Space (telemetering)
			273.0 - 328.6	Fixed Mobile
			328.6 - 335.4	Aeronautical radio navigation (glide-path systems)
			335.4 - 399.9	Fixed Mobile
			399.9 - 400.05	Radio navigation-satellite
Box 17	250.0 - 500.0			
	410	3.8×10^{-10}		
	430	4.8×10^{-11}		
	460	3.6×10^{-11}		

READINGS FROM SITE NUMBER 5, WASHINGTON MALL (continued)

Box no.	Frequency (MHz)	Power density (mW/cm^2)	FCC allocations	
			Frequency (MHz)	Service
Box 17 (cont'd)	250.0 - 500.0 (cont'd)		400.05 - 401.0	Meteorological aids Meteorological-satellite (maintenance, telemetering) Space research (telemetering and tracking)
			401.0 - 402.0	Meteorological aids Space (telemetering) Fixed Mobile except aeronautical
			402.0 - 406.0	Meteorological aids Fixed Mobile except aeronautical
			406.0 - 420.0	Fixed Mobile except aeronautical
			420.0 - 450.0	Radio location Amateur
			450.0 - 460.0	Fixed Mobile
			460.0 - 470.0	Fixed Mobile Meteorological-satellite
Box 18	500 - 1000	Below receiver sensitivity	470.0 - 890.0	Broadcasting
			890.0 - 942.0	Fixed Radio location
			942.0 - 960.0	Fixed
			960.0 - 1215	Aeronautical radio navigation
Box 19	1000 - 2500			
	1000	2.3×10^{-8}	1215 - 1300	Radio location Amateur
	1100	2.8×10^{-8}		
	1200	2.0×10^{-8}	1300 - 1350	Aeronautical radio navigation Radio location

READINGS FROM SITE NUMBER 5, WASHINGTON MALL (continued)

Box no.	Frequency (MHz)	Power density (mW/cm^2)	FCC allocations	
			Frequency (MHz)	Service
Box 19 (cont'd)	1000 - 2500 (cont'd)		1350 - 1400	Radio location
			1400 - 1427	Radio astronomy
			1427 - 1429	Fixed Mobile except aeronautical Space (telecommand)
			1429 - 1435	Fixed Mobile
			1435 - 1525	Mobile Fixed
			1525 - 1535	Space (telemetering) Fixed Mobile
			1535 - 1540	Space (telemetering)
			1540 - 1660	Aeronautical radio navigation
			1660 - 1664.4	Meteorological aids Meteorological-satellite
			1664.4 - 1668.4	Meteorological aids Meteorological-satellite Radio astronomy
			1668.4 - 1670	Meteorological aids Meteorological-satellite
			1670 - 1690	Meteorological aids Fixed Mobile except aeronautical
			1690 - 1700	Meteorological aids Meteorological-satellite
			1700 - 1710	Space research (telemetering and tracking)

READINGS FROM SITE NUMBER 5, WASHINGTON MALL (continued)

Box no.	Frequency (MHz)	Power density (mW/cm^2)	FCC allocations	
			Frequency (MHz)	Service
Box 19 (cont'd)	1000 - 2500 (cont'd)		1710 - 1770	Fixed Mobile
			1770 - 1790	Fixed Mobile Meteorological-satellite
			1790 - 2290	Fixed Mobile
			2290 - 2300	Space research (telemetering and tracking in deep space)
			2300 - 2450	Radio location Amateur Fixed Mobile
			2450 - 2550	Fixed Mobile Radio location
Box 20	2500 - 4500	Below receiver sensitivity	2550 - 2690	Fixed Mobile
			2690 - 2700	Radio astronomy
			2700 - 2900	Aeronautical radio navigation Radio location
			2900 - 3100	Radio navigation (ground-based radar) Radio location
Frequency (GHz)			Frequency (GHz)	
2.5 - 4.5 (cont'd)			3.100 - 3.300	Radio location
			3.300 - 3.400	Radio location Amateur
			3.400 - 3.500	Radio location Communication-satellite (satellite to earth) Amateur

READINGS FROM SITE NUMBER 5, WASHINGTON MALL (continued)

Box no.	Frequency (GHz)	Power density (mW/cm^2)	FCC allocations	
			Frequency (GHz)	Service
Box 20 (cont'd)	2.5 - 4.5 (cont'd)		3.500 - 3.700	Fixed Mobile Radio location Communication-satellite (satellite to earth)
			3.700 - 4.200	Fixed Mobile Communication-satellite (satellite to earth)
			4.200 - 4.400	Aeronautical radio navigation
Box 21	4.5 - 7.3	Below receiver sensitivity	4.400 - 4.700	Fixed Mobile Communication-satellite (earth to satellite)
			4.700 - 4.900	Fixed Mobile
			4.900 - 5.000	Radio astronomy
			5.000 - 5.250	Aeronautical radio navigation
			5.250 - 5.255	Radio location Space research
			5.255 - 5.350	Radio location
			5.350 - 5.460	Aeronautical radio navigation Radio location
			5.460 - 5.470	Radio navigation Radio location
			5.470 - 5.650	Maritime radio navigation Radio location
			5.650 - 5.670	Radio location Amateur

READINGS FROM SITE NUMBER 5, WASHINGTON MALL (continued)

Box no.	Frequency (GHz)	Power density (mW/cm^2)	FCC allocations	
			Frequency (GHz)	Service
Box 21 (cont'd)	4.5 - 7.3 (cont'd)		5.670 - 5.725	Radio location Amateur Space research (deep space)
			5.725 - 5.925	Radio location Amateur
			5.925 - 6.425	Fixed Mobile Communication-satellite (earth to satellite)
			6.425 - 7.250	Fixed Mobile
			7.250 - 7.300	Communication-satellite (satellite to earth)
Box 22	7.3 - 10.5	Below receiver sensitivity	7.300 - 7.750	Fixed Mobile Communication-satellite (satellite to earth)
			7.750 - 7.900	Fixed Mobile
			7.900 - 7.975	Fixed Mobile Communication-satellite (earth to satellite)
			7.975 - 8.025	Communication-satellite (earth to satellite)
			8.025 - 8.400	Fixed Mobile Communication-satellite (earth to satellite)

READINGS FROM SITE NUMBER 5, WASHINGTON MALL (continued)

Box no.	Frequency (GHz)	Power density (mW/cm^2)	FCC allocations	
			Frequency (GHz)	Service
Box 22 (cont'd)	7.3 - 10.5 (cont'd)		8.400 - 8.500	Space research
			8.500 - 8.750	Radio location
			8.750 - 8.850	Radio location Aeronautical radio navigation (air-borne doppler aid)
			8.850 - 9.000	Radio location
			9.000 - 9.200	Aeronautical radio navigation (ground-based radars) Radio location
			9.200 - 9.300	Radio location
			9.300 - 9.500	Radio navigation Radio location
			9.500 - 9.800	Radio location
			9.800 - 10.00	Radio location Fixed
			10.00 - 10.50	Radio location Amateur

APPENDIX D

POWER DENSITIES MEASURED AT TEN SITES IN THE WASHINGTON, D.C., AREA

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APPENDIX D

POWER DENSITIES MEASURED AT TEN SITES
IN THE WASHINGTON, D.C., AREA

Table D-1. Totals for site number 1, Holy Cross Hospital.

1. Total power density: 3.9×10^{-4} mW/cm^2

2. Total power densities over biologically significant frequency ranges:

Frequency (MHz)	Total power density (mW/cm^2)
0 - 400	3.9×10^{-4}
400 - 1000	4.3×10^{-9}
1000 - 3000	5.8×10^{-10}
3000 - 10000	Below receiver sensitivity

3. Total power densities over radio and television bands:

Band	Frequency (MHz)	Total power density (mW/cm^2)
Radio-AM	535 KHz - 1.605 MHz	3.5×10^{-4}
Radio-FM	88 MHz - 108 MHZ	4.3×10^{-5}
TV-VHF	54 MHz - 73 MHZ and 75.4 MHz - 88 MHz and 174 MHz - 216 MHz	3.9×10^{-7}
TV-UHF	470 MHz - 890 MHz	3.9×10^{-9}

Table D-2. Totals for site number 2, Montgomery Mall.

1. Total power density: 2.2×10^{-4}

2. Total power densities over biologically significant frequency ranges:

Frequency (MHz)	Total power density (mW/cm^2)
0 - 400	2.1×10^{-4}
400 - 1000	1.1×10^{-5}
1000 - 3000	1.8×10^{-7}
3000 - 10000	Below receiver sensitivity

3. Total power densities over radio and television bands:

Band	Frequency (MHz)	Total power density (mW/cm^2)
Radio-AM	535 KHz - 1.605 MHz	2.1×10^{-4}
Radio-FM	88 MHz - 108 MHz	1.1×10^{-6}
TV-VHF	54 MHz - 73 MHz and 75.4 MHz - 88 MHz and 174 MHz - 216 MHz	1.7×10^{-7}
TV-UHF	470 MHz - 890 MHz	1.1×10^{-5}

Table D-3. Totals for site number 3, Cameron Station.

1. Total power density: 3.2×10^{-5} mW/cm^2

2. Total power densities over biologically significant frequency ranges:

Frequency (MHz)	Total power density (mW/cm^2)
0 - 400	3.2×10^{-5}
400 - 1000	1.3×10^{-9}
1000 - 3000	3.4×10^{-8}
3000 - 10000	Below receiver sensitivity

3. Total power densities over radio and television bands:

Band	Frequency (MHz)	Total power density (mW/cm^2)
Radio-AM	535 KHz - 1.605 MHz	3.1×10^{-5}
Radio-FM	88 MHz - 108 MHz	5.5×10^{-9}
TV-VHF	54 MHz - 73 MHz and 75.4 MHz - 88 MHz and 174 MHz - 216 MHz	3.8×10^{-9}
TV-UHF	470 MHz - 890 MHz	9.7×10^{-10}

Table D-4. Totals for site number 4, Andrews Air Force Base.

1. Total power density: 2.2×10^{-5} mW/cm^2

2. Total power densities over biologically significant frequency ranges:

Frequency (MHz)	Total power density (mW/cm^2)
0 - 400	2.2×10^{-5}
400 - 1000	3.7×10^{-9}
1000 - 3000	9.3×10^{-8}
3000 - 10000	Below receiver sensitivity

3. Total power densities over radio and television bands:

Band	Frequency (MHz)	Total power density (mW/cm^2)
Radio-Am	535 KHz - 1.605 MHz	9.8×10^{-6}
Radio-FM	88 MHz - 108 MHz	8.4×10^{-6}
TV-VHF	54 MHz - 73 MHz and 75.4 MHz - 88 MHz and 174 MHz -216 MHz	3.5×10^{-6}
TV-UHF	470 MHz -890 MHz	3.7×10^{-9}

Table D-5. Totals for site number 5, Washington Mall.

1. Total power density: 2.6×10^{-5} mW/cm^2
2. Total power densities over biologically significant frequency ranges:

Frequency (MHz)	Total power density (mW/cm^2)
0 - 400	2.6×10^{-5}
400 - 1000	4.9×10^{-10}
1000 - 3000	1.1×10^{-7}
3000 - 10000	Below receiver sensitivity

3. Total power densities over radio and television bands:

Band	Frequency (MHz)	Total power density (mW/cm^2)
Radio-AM	535 KHz - 1.605 MHz	2.6×10^{-5}
Radio-FM	88 MHz - 108 MHz	2.2×10^{-8}
TV-VHF	54 MHz - 73 MHz and 75.4 MHz - 88 MHz and 174 MHz - 216 MHz	5.3×10^{-8}
TV-UHF	470 MHz - 890 MHz	3.0×10^{-11}

Table D-6. Totals for site number 6, Brentwood Park.

1. Total power density: 8.6×10^{-5} mW/cm^2

2. Total power densities over biologically significant frequency ranges:

Frequency (MHz)	Total power density (mW/cm^2)
0 - 400	8.6×10^{-5}
400 - 1000	Below receiver sensitivity
1000 - 3000	3.0×10^{-8}
3000 - 10000	Below receiver sensitivity

3. Total power densities over radio and television bands:

Band	Frequency (MHz)	Total power density (mW/cm^2)
Radio-AM	535 KHz - 1.605 MHz	8.6×10^{-5}
Radio-FM	88 MHz - 108 MHz	Below receiver sensitivity
TV-VHF	54 MHz - 73 MHz and 75.4 MHz - 88 MHz and 174 MHz - 216 MHz	Below receiver sensitivity
TV-UHF	470 MHz - 890 MHz	Below receiver sensitivity

Table D-7. Totals for site number 7, Sibley Hospital.

1. Total power density: 7.0×10^{-6} mW/cm^2

2. Total power densities over biologically significant frequency ranges:

Frequency (MHz)	Total power density (mW/cm^2)
0 - 400	6.8×10^{-6}
400 - 1000	1.0×10^{-7}
1000 - 3000	4.0×10^{-8}
3000 - 10000	Below receiver sensitivity

3. Total power densities over radio and television bands:

Band	Frequency (MHz)	Total power density (mW/cm^2)
Radio-AM	535 KHz - 1.605 MHz	3.2×10^{-6}
Radio-FM	88 MHz - 108 MHz	1.6×10^{-6}
TV-VHF	54 MHz - 73 MHz and 75.4 MHz - 88 MHz and 174 MHz - 216 MHz	7.8×10^{-7}
TV-UHF	470 MHz - 890 MHz	1.0×10^{-7}

Table D-8. Totals for site number 8, Duval High School.

1. Total power density: 7.5×10^{-7} mW/cm^2

2. Total power densities over biologically significant frequency ranges:

Frequency (MHz)	Total power density (mW/cm^2)
0 - 400	6.6×10^{-7}
400 - 1000	4.3×10^{-10}
1000 - 3000	8.8×10^{-8}
3000 - 10000	Below receiver sensitivity

3. Total power densities over radio and television bands:

Band	Frequency (MHz)	Total power density (mW/cm^2)
Radio-AM	535 KHz - 1.605 MHz	4.1×10^{-7}
Radio-FM	88 MHz - 108 MHz	4.5×10^{-9}
TV-VHF	54 MHz - 73 MHz and 75.4 MHz - 88 MHz and 174 MHz - 216 MHz	2.8×10^{-9}
TV-UHF	470 MHz - 890 MHz	4.3×10^{-10}

Table D-9. Totals for site number 9, National Airport.

1. Total power density: 7.9×10^{-3} mW/cm^2

2. Total power densities over biologically significant frequency ranges:

Frequency (MHz)	Total power density (mW/cm^2)
0 - 400	8.3×10^{-6}
400 - 1000	4.7×10^{-8}
1000 - 3000	7.7×10^{-3}
3000 - 10000	1.4×10^{-4}

3. Total power densities over radio and television bands:

Band	Frequency (MHz)	Total power density (mW/cm^2)
Radio-AM	535 KHz - 1.605 MHz	7.0×10^{-6}
Radio-FM	88 MHz - 108 MHz	9.6×10^{-8}
TV-VHF	54 MHz - 73 MHz and 75.4 MHz - 88 MHz and 174 MHz - 216 MHz	1.8×10^{-7}
TV-UHF	470 MHz - 890 MHz	4.6×10^{-8}

Table D-10. Totals for site number 10, Darnestown, Md.

1. Total power density: 2.5×10^{-4} mW/cm^2

2. Total power densities over biologically significant frequency ranges:

Frequency (MHz)	Total power density (mW/cm^2)
0 - 400	2.6×10^{-7}
400 - 1000	1.1×10^{-5}
1000 - 3000	2.4×10^{-4}
3000 - 10000	Below receiver sensitivity

3. Total power densities over radio and television bands:

Band	Frequency (MHz)	Total power density (mW/cm^2)
Radio-AM	535 KHz - 1.605 MHz	9.2×10^{-8}
Radio-FM	88 MHz - 73 MHz	1.2×10^{-8}
TV-VHF	54 MHz - 88 MHz and 75.4 MHz - 88 MHz and 174 MHz - 216 MHz	3.2×10^{-9}
TV-UHF	470 MHz - 890 MHz	1.1×10^{-5}

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Stephen W. Smith and David G. Brown
RADIOFREQUENCY AND MICROWAVE RADIATION LEVELS RESULTING FROM MAN-MADE SOURCES IN THE WASHINGTON, D.C., AREA.
USDHEW, Public Health Service, Food and Drug Administration, Bureau of Radiological Health. DHEW Publication No. (FDA) 72-8015, BRH Publication No. BRH/DEP 72-5 (November 1971) 56 pp. (limited distribution).
ABSTRACT: In order to determine the typical levels of radiofrequency and microwave radiation that result from man-made sources in an urban environment, measurements were made of peak power densities in the Washington, D.C., area during the summer of 1969. The highest levels measured (approximately 10^{-2} mW/cm^2) originated primarily from AM broadcast towers and airport radar installations.

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